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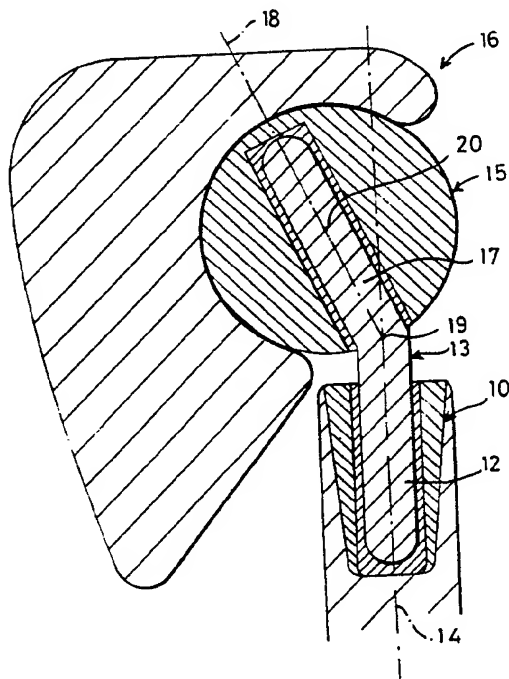
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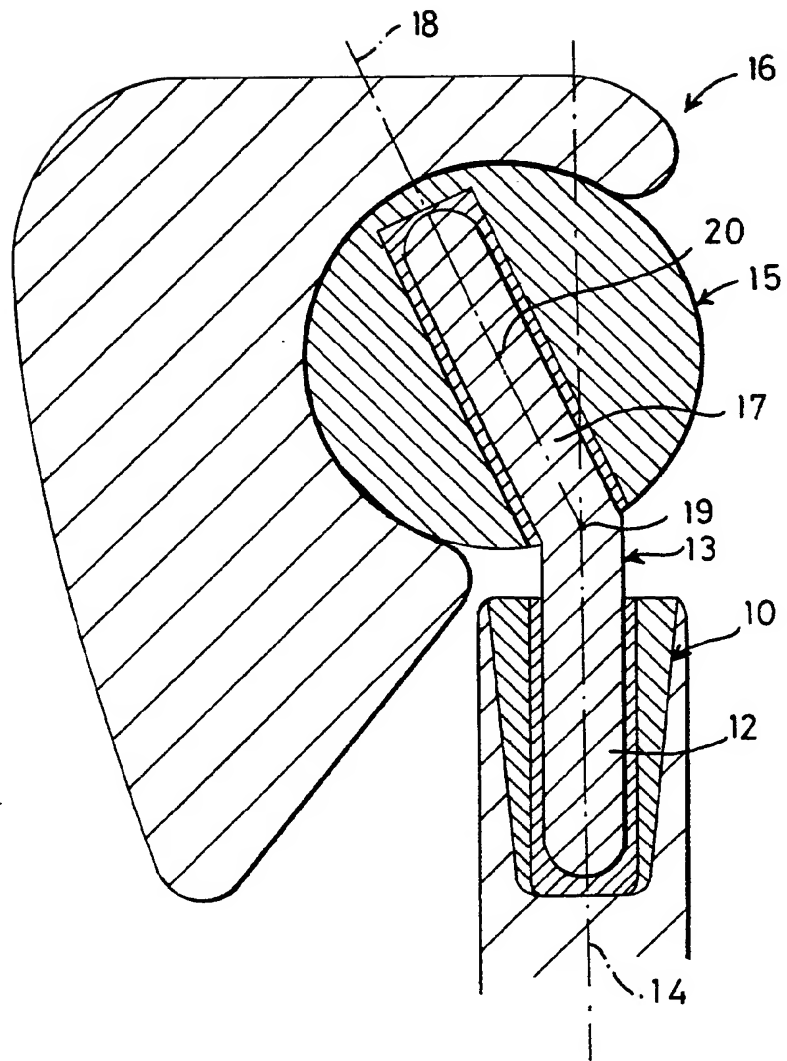
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(54) **Shoulder joint structure**

(57) A joint structure for use as a shoulder prosthesis comprises a first member (10) which is implanted in an end of the humerus (11), a spherical member (15) which is implanted in a socket in the scapula (16) and an intermediate member (13) which can pivot relative to the first and second members about respective axes (14, 18). These axes are mutually inclined (preferably at an angle in the region of 45°) and preferably intersect at a position in the intermediate member (13).



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Title: "Joint Structure"

Description of Invention

The present invention relates to a joint structure suitable for implantation in a human being to provide a connection between the humerus and the scapula.

A joint structure in accordance with the invention comprises a first member suitable for implantation in the humerus, a second member suitable for implantation in the scapula and an intermediate member which can turn relative to the first and second members about respective axes which are mutually inclined.

Said axes preferably intersect at a position which lies within the intermediate member.

The second member preferably has a part-spherical external surface which seats in a socket in the scapula to provide for turning of the second member relative to the scapula. The centre of curvature of the part-spherical surface preferably lies on the axis about which the intermediate member can turn relative to the second member, called herein the second axis.

The centre of curvature of the part-spherical surface of the second member is preferably spaced along the second axis from the axis about which the intermediate member can turn relative to the first member, called herein the first axis. The distance between the centre of curvature and the first axis, measured along the second axis, is preferably less than the diameter of the part-spherical surface but greater than one half of the radius of that surface.

An example of a joint structure embodying the present invention will now be described, with reference to the accompanying drawing, in which there is represented diagrammatically a scapula of a human being, an adjacent part of a humerus and a joint structure connecting the humerus with the scapula.

The joint structure comprises a first member 10 which is implanted in a socket formed in the humerus by cutting away bone from the humerus. The member 10 is typically of frusto-conical shape with an apex angle of less than 40° . The member 10 is preferably a press-fit in the socket formed in the humerus and is in substantially co-axial relation with the humerus. If required, an acrylic cement may be used to seal the interface between the member 10 and the bone of the humerus and to fix the member with respect to the humerus. In general, reaming of the humerus by means of a tool having a shape substantially the same as that of the member 10 will render use of a cement unnecessary.

Substantially the entire member 10 is disposed in the socket of the humerus. Typically, the member 10 has a length in the range 3 to 6 centimetre and a diameter at its wider end in the range 1.5 to 3 centimetre.

The member 10 is hollow and has a generally cylindrical cavity in co-axial relation with the external surface of the member, the cavity being open at the wider end of the member 10. In the cavity of the member 10, there is received one limb 12 of an intermediate member 13. This lower limb has a generally cylindrical external surface and the boundary surface of the cavity in the member 10 constitutes a bearing surface for the limb 12, so that the limb can turn relative to the member 10 about a first axis 14. The axis 14 extends along the humerus 11 and is substantially co-axial with the humerus.

The joint structure further comprises a second member 15 which is received in a socket formed in the scapula 16. More than one half of the member 15 is disposed in the socket of the scapula. The normal scapula has a socket, but the normal socket is not sufficiently large to receive more than one half of the member 15. Accordingly, bone is removed from the scapula to provide a socket of the required size.

The member 15 is hollow, having a generally cylindrical cavity in which there is received a second limb 17 of the intermediate member. This limb is substantially cylindrical and is received with a sliding fit within the cavity of the member 15, so that the intermediate member can turn relative to the member 15 about a second axis 18 defined by the boundary surface of the cavity in the member 15.

The first axis 14 intersects the second axis 18 at a position 19 which lies within the intermediate member 13, in the vicinity of the junction between the limbs 12 and 17. The axes 14 and 18 are mutually inclined, the included angle being within the range 30° to 60° .

The external surface of the second member 15 is spherical, the spherical surface being interrupted by the open end of the cavity in the second member. The boundary surface of the socket in the scapula 16 has a size and shape complementary to those of the external surface of the second member so that the member is a close sliding fit in the socket. It will be understood that the scapula is sufficiently flexible to admit the member 15, notwithstanding that the boundary surface of the socket in the scapula subtends at the centre of curvature an angle slightly greater than 180° .

The centre of curvature 20 of the external surface of the member 15 lies on the second axis 18 and is spaced along that axis from the intersection position 19 by a distance within the range 0.6 to 1.5 times the radius of curvature. Preferably, the spacing of the centre curve of curvature 20 along the axis 18 from the intersection position 19 is within 10% of the radius of curvature of the external surface of the member 15.

During preparation of the sockets in the humerus 11 and the scapula 16, the members 10 and 15 may be separated from the intermediate member 13 to facilitate checking of the fit of these members in their respective sockets. Once formation of the sockets has been completed, the first and second members of the joint structure are assembled with the intermediate member 13. The first member 10 of the assembly is then introduced into the socket of the humerus and the second member 15 of the assembly is then introduced into the socket of the scapula. Tissues of the patient extend over the joint structure from the scapula to the humerus and retain the components of the joint structure in assembled relation with one another and help to retain the member 15 in the socket of the scapula. The joint structure provides for substantially the same range of movement of the humerus 11 relative to the scapula 16 as is provided by a normal shoulder joint. During such movement, there is relative rotation at the interface between the intermediate member 13 and the first member 10 and also at the interface between the intermediate member and the second member 15. Large movements of the humerus relative to the scapula may result in some movement of the second member 15 relative to the scapula. The freedom for relative movement of components of the joint structure about the first and second axes almost eliminates the need for turning of the second member 15 relative to the scapula.

The second member may be formed of surgical quality stainless steel or of a ceramic. The external surface of this member has a quality of

smoothness which is usual for steel components to be implanted in the human body.

The intermediate member 13 is preferably formed of surgical quality stainless steel. The first member 10 and the second member 15 may both have linings which have a low co-efficient of sliding friction with respect to stainless steel. High density polyethylene is a suitable material for the linings. The first member 10 also may be formed of stainless steel or of a ceramic.

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

CLAIMS:-

1. A joint structure suitable for implantation in a human being to provide a connection between the humerus and the scapula, the joint structure comprising a first member suitable for implantation in the humerus, a second member suitable for implantation in the scapula and an intermediate member which can turn relative to the first and second members about respective axes which are mutually inclined.
2. A structure according to Claim 1 wherein said axis intersect one another.
3. A structure according to Claim 2 wherein the point of intersection of the axis lies within the intermediate member.
4. A structure according to any preceding Claim wherein the angle included between the axes is within the range 30° to 60° .
5. A structure according to Claim 4 wherein the angle is substantially equal to 45° .
6. A structure according to any preceding Claim wherein the second member has a part-spherical external surface.
7. A structure according to Claim 6 wherein the centre of curvature of the external surface lies on the axis about which the intermediate member can turn relative to the second member.
8. A joint structure according to Claim 6 or Claim 7 wherein the centre of curvature is spaced along the axis about which the intermediate member can turn relative to the second member from the other of said axis by a distance which is less than the diameter of curvature of said surface but is greater than one quarter of that diameter.

9. A structure according to Claim 6 or Claim 7 wherein the shortest distance between the centre of curvature and the axis about which the intermediate member can move relative to the first member is within the range 10 to 30 millimetre.

10. A joint structure substantially as herein described with reference to and as shown in the accompanying drawing.

11. Any novel feature or novel combination of features disclosed herein or in the accompanying drawing.